

Citation for published version:

Blain, D, Curran, T & Standage, M 2021, 'Psychological and behavioral correlates of early adolescents' physical literacy', *Journal of Teaching in Physical Education*, vol. 40, no. 1, pp. 157-165.
<https://doi.org/10.1123/JTPE.2019-0131>

DOI:

[10.1123/JTPE.2019-0131](https://doi.org/10.1123/JTPE.2019-0131)

Publication date:

2021

Document Version

Peer reviewed version

[Link to publication](#)

Publisher Rights

Unspecified

Copyright © 2020 . The final publication is available at Human Kinetics via <https://doi.org/10.1123/jtpe.2019-0131>

University of Bath

Alternative formats

If you require this document in an alternative format, please contact:
openaccess@bath.ac.uk

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

Psychological and behavioral correlates of early adolescents' physical literacy

Submission date: 6th June 2019

Re-Submission date: 10th September 2019

Re-Submission date 22nd October 2019

Re-submission date 1st January 2020

Abstract

Purpose. Physical literacy is understood to be important for adolescents' behavioral and psychological wellness. Yet, to date, limited empirical data exists to support such reasoning. Addressing this gap, the present study examined relationships between physical literacy and early adolescents' physical education (PE) engagement, leisure-time exercise behavior, and psychological well-being. **Method.** The physical literacy level of 187 early adolescents ($M_{age} = 12.84$, $SD = .55$, girls = 99) was measured using the Canadian Assessment for Physical Literacy (Healthy Active Living and Obesity Research Group, 2014). One week later, data pertaining to standardized measures of engagement in PE, leisure-time exercise behavior, and psychological well-being were collected. **Results.** Structural equation modeling revealed that physical literacy was positively correlated with PE engagement, leisure-time exercise, positive affect, and vitality, whereas it was negatively correlated with negative affect. **Conclusion.** Findings from this work substantiate the contention that physical literacy has manifold benefits for an early adolescents' behavioral and psychological wellness.

Keywords: Physical education, engagement, exercise, well-being.

Introduction

Physical literacy is understood to be important for child and adolescent development and health (e.g., Society of Health and Physical Educators America [SHAPE], 2013; United Nations Educational, Scientific and Cultural Organization [UNESCO], 2015; Whitehead, 2010). To date, physical literacy has been largely studied in regard to conceptualization, measurement, usefulness, and practical development (e.g., Tremblay & Lloyd, 2010; Whitehead, 2010). Such work has supported the adoption of several physical literacy interventions that show promise in supporting the health and well-being of children and adolescents (e.g., SHAPE, 2013; UNESCO, 2015). Yet despite advancements in measurement, it is surprising that very few studies have investigated the health-related behavioral and psychosocial outcomes of physical literacy. This study will therefore address this void in the extant literature by testing relationships between physical literacy and engagement in physical education (PE), leisure-time exercise behavior, and psychological well-being.

Physical Literacy

One of the most widely cited definitions of physical literacy describes it as the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life (International Physical Literacy Association, 2017). From this perspective, physical literacy is considered a holistic construct that encompasses not only a physical component, but also cognitive (i.e., knowledge and understanding), psychological (i.e., motivation and confidence) and behavioral (i.e., physical activity behavior) elements. Recently, a large-scale empirical study of physical literacy (Royal Bank of Canada Learn to Play-Canadian Assessment of Physical Literacy, 2018) has been reported by Tremblay and his colleagues using their Canadian Assessment of Physical Literacy (CAPL) measurement tool (Healthy Active Living and Obesity Research Group

[HALO], 2014; Longmuir et al., 2015; Tremblay et al., 2018). The CAPL is currently the only, and widely accepted, measurement tool available for assessing holistic physical literacy that has peer-reviewed support for its systematic development, validity, and reliability (HALO, 2014; Francis et al., 2016; Longmuir et al., 2015). Within the CAPL, an overall physical literacy score is calculated based on measures relating to the four domains identified by the International Physical Literacy Association definition (i.e., physical competence, motivation and confidence, knowledge and understanding, daily behavior). Initial data from a sample of 10,034 Canadian children showed that boys and older children tended to have higher levels of physical literacy than girls and younger children (Tremblay et al., 2018).

Using the Royal Bank of Canada Learn to Play-CAPL data, associations among the different aspects of physical literacy have been reported (Belanger et al., 2018; Lang et al., 2018). Lang et al. (2018) reported a positive relationship between overall physical literacy and cardiorespiratory fitness. Similarly, Belanger et al. (2018) reported a positive relationship between physical literacy and physical activity and a negative relationship between physical literacy and sedentary behavior. Collectively, these findings provide initial insight into the value of physical literacy, yet further empirical research exploring the relationships between physical literacy and a broader array of health and well-being outcomes is needed (Longmuir & Tremblay, 2016). In this study, we focus on outcomes related to engagement in school PE, self-reported leisure-time exercise behavior, and psychological well-being.

Physical literacy and engagement in school PE

Engagement, broadly defined, is an individual's level of active involvement in a learning activity (Skinner & Belmont, 1993). When engaged, individuals demonstrate focus, interest, and persistence (Reeve, Jang, Carrell, Jeon & Barch, 2004). In school contexts, engaged pupils are believed to challenge themselves, act independently, and exert intense effort and concentration and generally show positive emotions such as enthusiasm, optimism

and curiosity when completing tasks (Skinner & Belmont, 1993). To this end, empirical research has shown engagement to be positively associated with several adaptive outcomes in school, including greater achievement, enhanced learning, and better skill development (Skinner & Belmont, 1993). When assessed in school contexts, academic engagement has been measured via four core elements, namely behavioral (i.e., active participation with effort and persistence), cognitive (i.e., psychological investment in learning and cognition within tasks), emotional (i.e., feelings in relation to teachers, peers and school), and agentic (i.e., student contribution to the flow and instruction received) (Reeve & Tseng, 2011).

Although engaged participation in PE is considered important for physical activity and health (Sallis et al., 2012), researchers have not explored the interplay among physical literacy and PE engagement. This is somewhat surprising as physical literacy and its components are likely to be highly influential in how pupils behave, think, and feel in PE. For instance, one component of physical literacy – motivation – is well understood to be influential in pupil engagement (e.g., Curran, Hill, Ntoumanis, Hall, & Jowett, 2016; Reeve et al, 2004). Relatedly, competence is an important antecedent of well-integrated motivation (Ryan & Deci, 2017) and as such, integration of physical competence and confidence within physical literacy makes it likely to also be influential in PE engagement. Other research is also suggestive. Two systematic reviews demonstrate a positive relationship between motor competence (a component of physical competence) and behavioral engagement in physical activity broadly (Lubans, Morgan, Cliff, Barnett & Okely, 2010). Likewise, the reported positive relationship established between children’s physical literacy and physical activity behavior (Belanger et al., 2018) provides further evidence of the importance of physical literacy towards behavioral engagement to physical activity. Further, higher levels of motor skills have been shown to relate to enhanced moderate to vigorous physical activity (MVPA)

time in PE (Fairclough, Stratton & Baldwin, 2002). Collectively, theory and research suggest that physical literacy is likely to share a positive association with engagement in PE.

Physical literacy and leisure-time exercise behavior

Participation in regular exercise or physical activity during adolescence has long been associated with a range of positive health outcomes (Hallal, Victoria, Azevedo, & Wells, 2006; Janssen & LeBlanc, 2010; Poitras et al., 2016; Telema et al., 2014). Although the terms are often used interchangeably, physical activity concerns any bodily movement that results in energy expenditure, whereas exercise reflects the planned and purposeful engagement with physical activity (Caspersen, Powell, & Christenson, 1985). Individuals are likely to engage in physical activity behaviors of varying frequencies, intensities, durations, and types throughout their daily lives. However, sufficient time periods of MVPA are currently advocated for health benefit (World Health Organization [WHO], 2010). For young people, a minimum of 60 minutes MVPA per day is recommended (WHO, 2010). Yet, data show that only a limited number of young people meet MVPA recommendations worldwide (Sallis et al., 2016; Tremblay et al., 2016). Given that much incidental physical activity has been engineered out of daily living (Katzmarzyk & Mason, 2009), more purposeful engagement in physical activity during free time (i.e., leisure-time exercise) is often required to achieve health-enhancing levels of physical activity. Thus, it is important to understand the factors associated with leisure-time exercise behavior.

Physical literacy may be one construct that is positively associated with exercise behavior because its core components (i.e., physical competence, motivation, confidence and knowledge, and understanding) are considered important correlates or determinants of lifelong physical activity (Longmuir & Tremblay, 2016). Evidence is generally supportive of the importance of physical literacy towards exercise behaviors and overall physical activity in young people (e.g., Belanger et al., 2018; Biddle, Atkin, Cavill, & Foster, 2011). The

relationship between physical literacy and physical activity during free time (i.e., leisure-time exercise) is, however, yet to be explored. However, research appears supportive of a positive relationship. For example, Taylor, Ntoumanis, Standage, and Spray (2010) reported that perceived competence positively predicted exercise intentions and leisure-time physical activity during adolescence. Similarly, research has shown adolescents' perceived athletic competence at the beginning of the academic year to predict sport and exercise participation 7- and 14-months later (Papaioannou, Bebetos, Theodorakis, Christodoulidis, & Kouli, 2006). Further, during childhood, higher levels of motor coordination at baseline have been found to predict sport participation (considered volitional) two years later (Vandorpe et al., 2012). As such, we consider theory and past research to be supportive of a positive relationship between physical literacy and leisure-time exercise behavior.

Physical literacy and psychological well-being

Alongside engagement in PE and leisure-time exercise behavior, physical literacy is likely to contribute to psychological well-being among children and adolescents. Psychological well-being is a multidimensional construct consisting the presence of positive affect, the absence of negative affect, and the presence of vitality (Ryan & Frederick, 1997). Positive and negative affect are hedonic indicators of psychological well-being and encapsulate feelings of pleasure or distress respectively. Vitality is a eudemonic form of psychological well-being and encapsulates a relative state of "energy and aliveness" (Ryan & Frederick, 1997, p. 530). Recent reports document a rise in mental health issues amongst young people, thus there is an urgent need to explore factors related to the psychological well-being of children and adolescents (WHO, 2017).

As a construct that draws upon factors from a range of domains (i.e., physical, affective, cognitive), physical literacy may represent an important foundation to young people's psychological well-being. Indeed, and drawing upon the philosophical concept of

embodiment, Whitehead (2010) proposed that physical literacy is an important individual capability that makes a significant contribution to quality of life. One potential mechanism linking physical literacy to enhanced psychological well-being is via physical competence and associated perceptions of competence (i.e., confidence). Indeed, experiencing perceptions of competence is considered essential for psychological growth and wellness (Ryan & Deci, 2017). Research supports these ideas. For example, studies have demonstrated a positive association between satisfaction of the psychological need for competence in physical activity related contexts and aspects of psychological well-being (e.g., Standage, Duda, & Ntoumanis, 2003; Standage & Gillison, 2007). Additionally, higher levels of physical competence have been associated with more pleasurable physical activity experiences (Carroll & Loumidis, 2001). Collectively, then, theory and past research are supportive of a positive association between physical literacy and psychological well-being.

The Present Study

Physical literacy has been identified as being influential for child and adolescent health. Yet to date very little research has been conducted to examine the outcomes of physical literacy. Accordingly, the aim of this study was to test associations of physical literacy with early adolescents' PE engagement, leisure-time exercise behavior, and psychological well-being (i.e., indexed by scores to measures of positive affect, negative affect, and vitality). Based on the aforementioned theory and past empirical research, we hypothesized that physical literacy would positively correlate with PE engagement, leisure-time exercise behavior, vitality, and positive affect. By contrast, it was hypothesized that physical literacy would negatively correlate with negative affect.

Method

Participants and Procedure

Prior to commencing the study, ethical approval was provided by the research ethics approval committee of the lead author's university. A sample of 187 participants ($M_{\text{age}} = 12.84$, $SD = .55$, girls = 99, boys = 87, ethnicity = 93% White) were recruited from two schools from South Wales. These participants were invited to complete the Canadian Assessment for Physical Literacy (CAPL: HALO, 2014). Following the CAPL guidance (HALO, 2014), the CAPL was administered over a two-day period. On day one, participants completed the obstacle course, plank and anthropometric measures, and were issued with a pedometer. On day two, participants completed PACER test, sit and reach test, grip strength test, and completed the CAPL questionnaire. Pedometers were collected after a minimum of eight days at a convenient time for schools. One week following the CAPL measurements, a multi-item questionnaire pack was administered to assess the participants' engagement in PE, leisure-time exercise behavior, positive and negative affect, and vitality. Data were collected throughout the school year.

Instruments

Physical literacy. The Canadian Assessment for Physical Literacy, Version 1 (CAPL; HALO, 2014) was used to measure physical literacy. An overall physical literacy score (out of 100) is calculated from the CAPL from the subcomponent scores of daily behavior, motivation and confidence, knowledge and understanding, and physical competence. Based on their overall physical literacy score, participants are categorized as 'beginning', 'progressing', 'achieving', or 'excelling' on their physical literacy journey.

Daily behavior was assessed using a seven-day pedometer step count protocol and via self-reported MVPA and sedentary behavior. A pedometer (Fastime-Ped 1, Leicestershire, England) was distributed to all participants to wear for eight consecutive days. Consistent with the CAPL manual (Version 1), participants recorded their daily step count using the pedometer tracking log provided in the CAPL manual (HALO, 2014). Day one was used as a

familiarization day and these data were not recorded and used in analysis. As outlined in the CAPL manual (HALO, 2014), a minimum wear time of 10 hours per day (Eisenmann, Laurson, Wickel, Gentile, & Walsh, 2007), and step counts between 1,000 and 30,000 steps were considered valid (Tudor Locke, McClain, Hart, Sisson, & Washington, 2009). Further, at least three or more valid days of pedometer measurement was required to be included in the final analysis (Tudor-Locke et al., 2009). As outlined in the CAPL manual, pedometer step counts provide a more direct, objective measure for physical activity than self-reported data (HALO, 2014). Moreover, and in comparison to accelerometers, the relatively low cost, simplicity of initialization and analysis, reliability, and unobtrusive nature of pedometers make them an ideal tool for researchers to use with large samples (Colley, Janssen & Tremblay, 2012). Previous research with the CAPL has supported the effectiveness of following these protocols for collecting and analyzing pedometer step counts with groups of young people (e.g., Tremblay et al., 2018; see Corder, Ekelund, Steele, Wareham & Brage, 2008 regarding the reliability and validity of different methods of assessing physical activity). MVPA levels were recorded via self-report of the number of days in the past week that participants were physically active for at least 60 minutes. Specifically, participants were asked “During the past week (7 days), on how many days were you physically active for a total of at least 60 minutes per day? (all the time you spent in activities that increased your heart rate and made you breathe hard).” Sedentary behavior scores were calculated from participant responses to the number of hours they usually spend watching TV and playing video games on a school day or a weekend day. Information on the validity and reliability of scores to these self-reported measures have previously been reported in the Youth Risk Behavior Surveillance System (Brener et al., 2013). Pedometer scores, MVPA, and sedentary behavior scores were calculated using the scoring systems provided in the CAPL manual

(HALO, 2014). A total daily behavior score out of 32 was calculated by adding the CAPL pedometer step score to the total screen time score and the weekly time spent in MVPA.

Motivation and confidence were assessed using the Children's Self-Perceptions of Adequacy in and Predilection for Physical Activity (CSPAPPA; Hay, 1992). This scale requires participants to respond to a range of items in answer to the stem "what is most like you". Participants firstly select from two options (e.g., Adequacy – "some kids are good at active games" or "other kids find active games hard to play", and Predilection – "some kids don't like playing active games"), before outlining if the statements were "really true" or "sort of true" for them. Individual adequacy and predilection items are scored from one to four. Adequacy scores were then summed, multiplied by 1.5 and divided by seven (HALO, 2014). Predilection scores were summed and divided by nine (HALO, 2014). Overall motivation and confidence scores were calculated by adding the adequacy and predilection scores. Participants also respond to two individual items asking them to rate their own activity and skill levels with that of their peers on a 1-10 Likert scale. This score is divided by 10 and added to the adequacy and predilection scores to provide an overall motivation and confidence out of 14. The benefits to barriers ratio score was not included due to issues with children misunderstanding items from this measure. Similar findings have been reported elsewhere (e.g., Gunnell et al., 2018). However, and in order to maintain an overall score out of 18 for the motivation and confidence domain, a fractional method was used to scale the score out of 14 up to 18. The overall score out of 14 was divided by 14 then multiplied by 18. Scores provided to the CSPAPPA have previously shown good test-retest reliability and adequate validity (Hay, 1992).

Knowledge and understanding was assessed using the questionnaire developed specifically for the CAPL (HALO, 2014). Within this, an overall knowledge and understanding score out of 18 is calculated from participant responses to items relating to the

participant's knowledge of the physical activity and sedentary behavior recommendations, awareness of fitness and movement skill parameters and methods for their improvement, use of safety equipment during physical activity and perceptions of health (HALO, 2014; Longmuir et al., 2015). An example item for the knowledge and understanding component asked participants to circle one of four responses to the question, "if you wanted to get better at a sport skill like kicking and catching a ball, what would be the best thing to do?" Scores provided to the knowledge and understanding domain have been shown to provide support for the factorial structure of this component as part of an overall physical literacy score (Longmuir et al., 2015).

Finally, physical competence was calculated by adding the participants CAPL scores for motor competence, musculoskeletal fitness, cardiorespiratory fitness, and body composition (HALO, 2014). Motor competence was calculated from individual scores on the Canadian Agility and Movement Skill Assessment (CAMSA; Longmuir et al., 2017). Participant skills within the CAMSA were assessed by the lead author. Musculoskeletal fitness was calculated from pupils scores on the sit and reach assessment of flexibility (Canadian Society for Exercise Physiology, 2013), an assessment of grip strength (Canadian Society for Exercise Physiology, 2013), and the assessment of plank torso strength (Boyer et al., 2013). Cardiorespiratory fitness was assessed using the Fitnessgram 20m progressive aerobic cardiovascular endurance run (PACER; Meredith & Welk, 2010). Finally, body composition was assessed using body mass index (height, weight; Canadian Society for Exercise Physiology, 2013) and waist circumference (Canadian Society for Exercise Physiology, 2013). The overall score for physical competence out of 32 was calculated using the scoring system outlined in the CAPL manual (HALO, 2014).

Scores provided to the CAPL have been shown to provide a valid and reliable measure of physical literacy, as defined by the International Physical Literacy Association (2017).

First, extensive development of the CAPL via a 3-round Delphi process with 19 internationally-leading physical activity/fitness experts ensured agreement on the validity of the overall conceptualization, the specific assessment protocols included, and the scoring system incorporated within the measure (Francis et al., 2016). Second, further testing of the CAPL with a large sample of participants demonstrated acceptable factorial structure for the measure along with close relationships with teacher derived ratings (Longmuir et al., 2015).

Engagement in PE. Engagement in PE was measured using an adapted version of the classroom engagement measure developed by Reeve and Tseng (2011). This measure assesses agentic (e.g., “during PE, I ask questions”), behavioral (e.g., “I pay attention in PE”), emotional (e.g., “PE is fun”) and cognitive (e.g., “when I study, I try to relate what I’m learning to what I already know”) components of engagement. Participants were asked to respond to 19-items on a 7-point Likert scale to indicate the extent to which they agree. Scores to this measure have previously demonstrated acceptable factorial structure and internal consistency ($\alpha = .87$; Cheon, Reeve & Moon, 2012; Reeve & Tseng, 2011).

Leisure-time exercise behavior. Leisure-time exercise behavior was assessed using the Leisure Time Exercise Questionnaire (LTEQ; Godin & Shephard, 1997). Responses to the LTEQ require participants to report how many times over a typical week they have spent undertaking strenuous, moderate and light exercise of at least 15 minutes during their free time. An overall leisure-time exercise score is calculated using the following formula (total exercise score = [number of strenuous bouts x 9] + [number of moderate bouts x 5] + [number of light bouts x 3]). Scores to this measure have demonstrated support for the LTEQ’s psychometric properties in child samples (e.g., Biddle, Gorely, Pearson, & Bull, 2011). For example, a test-retest reliability coefficient of $\alpha = .74$ has been reported (Godin & Shephard, 1985). Further, validity and reliability of LTEQ scores have been judged as acceptable in two

reviews (Biddle, Gorely, Pearson, & Bull, 2011; Hidding, Chinapaw, van Poppel, Mokkink, & Altenburg, 2018).

Psychological well-being. The 10-item positive and negative affect schedule for children (PANAS-C; Ebesutani et al., 2012) was used to assess the participants' positive and negative affect. To assess positive affect, participants reported the extent to which they felt happy, cheerful, proud, joyful, and lively, over the past few weeks using a 5-point Likert scale. Conversely, to assess negative affect, participants indicated on the same Likert scale, the extent to which they felt sad, scared, miserable, afraid, and mad. Scores provided to the PANAS-C have demonstrated acceptable factorial structure and internal consistency (i.e., positive affect $\alpha = .86$, negative affect $\alpha = .82$; Ebesutani et al., 2012). Vitality was measured using the subjective vitality scale (Ryan & Frederick, 1997; Bostic, Rubio, & Hood, 2000). Within this tool, participants responded to 6-items (e.g., "I feel alive and vital") on a 7-point Likert scale. Scores provided to the subjective vitality scale have been shown to support acceptable factorial structure (Ryan & Frederick, 1997) and good internal consistency in adolescent samples (e.g., $\alpha = .88$; Taylor & Lonsdale, 2010).

Analytic Strategy

Initially, descriptive statistics (i.e., means, standard deviations, correlations, alpha coefficients) were calculated. Using AMOS version 22.0 (Arbuckle, 2013), the main analysis was then undertaken using two-phased structural equation modeling procedure (Anderson & Gerbing, 1988). Initially, a measurement model was tested using confirmatory factor analysis (CFA). This enabled the adequacy of the relationships between individual items and their latent constructs to be examined. Following the CFA, a structural equation model encompassing the hypothesized relationships was tested. The overall fit of data for both the measurement and structural models was assessed by using a set of fit indices which compare the variance-covariance matrix of the sample data to the variance-covariance matrix of the

model-implied data. A close match between sampled and hypothesized variances and covariances, as indicated by the fit statistics, would show the hypothesized data to be adequately represented by the sample data. The fit of the measurement and structural models were determined using conventional standards and deemed acceptable if CFI and TLI $\geq .90$ and RMSEA and SRMR $\leq .10$ (Marsh, Hau, & Wen, 2004). Statistical significance was set at $p = .05$. Effect sizes were calculated as the proportion of variance shared by physical literacy and each dependent variable using the coefficient of determination (i.e., R^2).

Results

Preliminary Analysis

One hundred and eighty-seven children commenced the CAPL physical competency protocols, CAPL questionnaire, and were administered with a pedometer. Missing value analysis showed that 127 participants had complete physical competency data (i.e., nine complete protocols). Missing physical competence data emerged as a result of absence on day of testing ($n = 32$) and declining participation on a specific protocol ($n = 28$). Following the CAPL manual guidance (HALO, 2014, p.18), a fractional method was used to calculate an overall physical competence score from the participants' available protocol results. Additionally, 68 participants (36%) failed to provide valid pedometer data (HALO, 2014), leading to further missing data. Given that a total physical literacy score can be calculated with a maximum of one complete missing protocol (HALO, 2014; Francis et al., 2016), participants with only the pedometer step count score missing were retained in the sample.

To maintain the pattern of physical literacy scores, for participants only missing the pedometer step count score, a fractional imputation method was used. Here, the overall physical literacy score (out of 100) was determined by dividing the total score recorded from the completed protocols by the maximum possible score (i.e., 79), and then multiplying this number by 100. This yielded a final sample of 158 with complete physical literacy data. Of

these, 150 were available to complete the follow up questionnaire pack. Analysis of missing values at time point two revealed 14 participants with over 10% missing data or incomplete leisure time exercise data. These participants were removed, leaving a total of 136 participants. A mean-substitution from the completed sub-scale items was utilized to impute remaining missing data. In accordance with Tabachnick and Fidell (2007), 11 significant univariate outliers were identified and removed (z -scores larger than 3.29, $p < .001$) and no multivariate outliers were identified using Mahalanobis distances greater than $\chi^2(9) = 27.88$ ($p < .001$). Following the removal of these cases, a final sample of 125 participants was available for analysis ($M_{age} = 12.82$, $SD = .54$, girls = 69, boys = 55, 1 not disclosed).

Bivariate correlations, means, standard deviations, and alpha coefficient values are shown in Table 1. Analyses revealed positive relationships between physical literacy and all elements of PE engagement, leisure-time exercise behavior, positive affect, and vitality. There was a negative correlation between physical literacy and negative affect. These findings lend initial support to our hypotheses.

Primary analysis

The measurement model contained four latent variables (PE engagement with four sub-scale indicators, positive affect with 5 item indicators, negative affect with 5 item indicators, and vitality with 6 item indicators) and two observed variables (physical literacy and leisure time physical activity). Covariances were specified between the disturbance terms of positive affect, negative affect, and vitality to reflect the common association among these variables in previous empirical research (e.g., Gagne, Ryan & Bargmann., 2003). Analyses of individual factor loadings from the measurement model revealed two items from the negative affect scale loaded poorly (i.e., $< .40$; Hair, Black, Babin, & Anderson, 2010) onto their respective latent variable and were therefore removed. With these items removed, the measurement model demonstrated good fit to the data ($TLI = .94$, $CFI = .95$, $\chi^2 = 205.01$

(157), $p < .05$, RMSEA = .05, SRMR = .06). In stage two, the hypothesized structural model was tested. Fit statistics showed the structural model to have an adequate fit to the data (TLI = .91, CFI = .93, $\chi^2 = 236.59$ (164), $p < .05$, RMSEA = .06, SRMR = .11). Detailed analysis of the structural model showed several significant relationships between the study variables that are presented in Figure 1. Physical literacy was significantly and positively related to engagement in PE ($\beta = .57$, $p < .001$, $R^2 = .33$), levels of leisure-time exercise ($\beta = .38$, $p < .001$, $R^2 = .14$), vitality ($\beta = .53$, $p < .001$, $R^2 = .28$), positive affect ($\beta = .39$, $p < .001$, $R^2 = .15$), and significantly and negatively related to negative affect ($\beta = -.25$, $p < .05$, $R^2 = .06$). Overall, physical literacy explained 33% of variance in PE engagement, 14% of variance in leisure-time exercise, 28% of variance in vitality, 15% of variance in positive affect, and 6% of variance in negative affect.

Discussion

As recently highlighted by scholars (e.g., Longmuir & Tremblay, 2016), an important and missing avenue of research pertains to better understanding the outcomes of physical literacy. In an initial attempt to address this gap, we examined the relationships between physical literacy and engagement in PE, leisure-time exercise behavior, and the psychological well-being of early adolescents. Using a prospective design, the results of the present work support the importance of physical literacy by demonstrating positive relationships between physical literacy and engagement in PE, leisure-time exercise behavior, and psychological well-being as well as a negative association between physical literacy and negative affect.

Physical Literacy and Engagement in PE

Results of this study showed a positive relationship between physical literacy and engagement in PE. The positive association with physical literacy and engagement in PE has several important implications. First, as a context that provides structured physical activity experiences for all young people, engagement in PE is highly salient for physical health (e.g.,

Fairclough, Stratton, & Baldwin, 2002; Sallis et al., 2012). One of the ways through which physical literacy may enhance physical health, then, is via heightened engagement in PE. Second, our findings highlight the potential risks of disengagement from secondary school PE among pupils who have not yet developed adequate levels of physical literacy. It appears essential that physical educationalists consider how their pedagogical approaches support the needs of all pupils and particularly those with lower levels of physical literacy. Strategies such as making activities meaningful and relevant, providing choice, optimal challenge, and structure are essential (Ntoumanis & Standage, 2009). Finally, research shows that engagement and motivation share a reciprocal relationship (e.g., Curran et al., 2016). Hence, it is likely that just as physical literacy contributes to PE engagement, PE engagement may also contribute to physical literacy.

Physical Literacy and Leisure-Time Exercise

We also found that physical literacy shared a positive association with leisure-time exercise. This finding adds to the recent results of Belanger et al.'s (2018) work wherein they reported a positive relationship between physical literacy and physical activity and a negative association between physical literacy and sedentary behavior. Considering that much incidental physical activity has been removed from daily lives (Katzmarzyk & Mason, 2009), achieving health-enhancing levels of physical activity requires participation in more purposeful activity (i.e., leisure-time exercise). Thus, the positive relationship between physical literacy and leisure-time exercise behavior reported in our work has important health implications for young people. First, short-term benefits of exercise participation include enhanced musculoskeletal and cardiovascular health and fitness, lowered fat mass, and higher self-esteem (Hallal et al., 2006; Janssen & LeBlanc, 2010). Second, longer-term benefits may be associated with participation in leisure-time exercise during adolescence, potentially, via

the tracking of exercise behaviors into young adulthood and/or by offsetting the development of future health conditions (Hallal et al., 2006; Telema et al., 2014).

Physical Literacy and Psychological Well-being

The results from this study also demonstrated a positive relationship between physical literacy and positive affect and vitality. Conversely, physical literacy shared a negative association with negative affect. Previous research has demonstrated positive relationships between physical activity and psychological well-being (Poitras et al., 2016). Further, within her philosophical basis for physical literacy, Whitehead (2010) suggests that being “physically literate can make a significant contribution to quality of life” (p. 32). The positive relationships found between physical literacy and positive affect and vitality lends support to these ideas. Here, our findings indicate how, in addition to developing physical health, supporting the development of physical literacy can also hold important psychological benefits for young people. This is particularly important given the rising mental health issues reported amongst young people (WHO, 2017), with our findings suggesting that physical literacy may be one pathway through which these issues might be alleviated.

Limitations and future research

This study has limitations. The homogenous nature of the sample means that findings cannot be generalized. Relatedly, the small effective sample size used is also a limitation. Future research should therefore aim to further explore outcomes associated with physical literacy in larger and more diverse samples. The recent release of a streamlined CAPL 2.0 (HALO, 2017) enhances the practicalities of such research by decreasing the burden on participants, gatekeepers, and researchers. However, the use of this tool is not without challenges. Specifically, we were able to maintain sample size in our study through following guidance in the CAPL 1.0 manual (HALO, 2014) to maintain some participants only missing pedometer step count within our sample. Yet, in the CAPL 2.0, this is not advised, meaning

future research may require large sample sizes to account for attrition. Further, detailed analysis of the true nature of missing pedometer data is advised. Additionally, some participants in our sample were 12-13 years of age, slightly above the age range of the CAPL. However, at present there is not an alternative, validated measure for assessing the physical literacy of adolescents. Future work should seek to address this gap. Yet, it is of note that a ceiling effect was not detected in the sample, hence suggesting the CAPL to potentially be a suitable measure of physical literacy for 13-year old pupils. Next, and despite the prospective nature of the research design, the data remains correlational and therefore causal relationships cannot be inferred. Likewise, we cannot ascertain the directionality of relations. In the case of PE engagement and leisure-time exercise, reciprocal relationships are especially likely. Longitudinal research is therefore required to monitor variables over time. Finally, and although past work has demonstrated mean differences among physical literacy dimensions to exist (Tremblay et al., 2018), it would be interesting in future work with appropriately powered sample to examine the invariance of associations among physical literacy and outcome variables across potentially important covariates such as age (including relative age effect), gender, socioeconomic status, and cultural background.

Conclusion

This study adds to a vastly limited body of empirical research examining the correlates of physical literacy in early adolescents. The present findings show physical literacy to contribute to a number of adaptive outcomes including PE engagement, leisure-time exercise behavior, and psychological well-being. As such, our findings support the longstanding contention that physical literacy contributes to young people's development, health, and wellness. Further to this, our data also adds to the assertion that the development of physical literacy should be a target of early intervention (Whitehead, 2010).

References

- Anderson, J., & Gerbing, D. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin*, 103, 411-423.
- Arbuckle, J. L. (2013). *AmoSTM 22 user's guide*. Chicago, IL: SPSS.
- Belanger, K., Barnes, J., Longmuir, P., Anderson, K., Bruner, B., & Copeland, J., ... Tremblay, M. (2018). The relationship between physical literacy scores and adherence to Canadian physical activity and sedentary behavior guidelines. *BMC Public Health*, 18(S2).
- Biddle, S., Atkin, A. J., Cavill, N., & Foster, C. (2011). Correlates of physical activity in youth: A review of quantitative systematic reviews. *International Review of Sport and Exercise Psychology*, 4, 25-49.
- Biddle, S., Gorely, T., Pearson, N., & Bull, F. (2011). An assessment of self-reported physical activity instruments in young people for population surveillance: Project ALPHA. *International Journal of Behavioral Nutrition and Physical Activity*, 8, 1.
- Bostic, T. J., Rubio, D. M., & Hood, M. (2000). A validation of the subjective vitality scale using structural equation modeling. *Social Indicators Research*, 52, 313-324.
- Boyer, C., Tremblay, M., Saunders, T., McFarlane, A., Borghese, M., Lloyd, M., & Longmuir, P. (2013). Feasibility, validity, and reliability of the plank isometric hold as a field-based assessment of torso muscular endurance for children 8–12 years of age. *Pediatric Exercise Science*, 25, 407-422.
- Brener, N.D., Kann, L., Shanklin, S., Kinchen, S., Eaton, D.K., Hawkins, J., & Flint, K.H. (2013). Methodology of the Youth Risk Behavior Surveillance System. *Morbidity and Mortality Weekly Report*, 62(1), 1-20.

- 1 Canadian Society for Exercise Physiology. (2013). Canadian society for exercise physiology
2 physical activity training for health (CSEP-PATH). Ottawa, ON: Canadian Society for
3 Exercise Physiology.
- 4 Carroll, B., & Loumidis, J. (2001). Children's perceived competence and enjoyment in
5 physical education and physical activity outside school. *European Physical Education*
6 *Review*, 7, 24-43.
- 7 Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and
8 physical fitness: Definitions and distinctions for health-related research. *Public Health*
9 *Reports*, 100, 126-131.
- 10 Cheon, S.H., Reeve, J., & Moon, I.S. (2012). Experimentally based, longitudinally designed,
11 teacher-focused intervention to help physical education teachers be more autonomy
12 supportive toward their students. *Journal of Sport and Exercise Psychology*, 34, 365-
13 396.
- 14 Colley, R.C, Janssen, I., & Tremblay, M.S. (2012). Daily step target to measure adherence to
15 physical activity guidelines in children. *Medicine and Science in Sports and Exercise*,
16 44(5), 977-982.
- 17 Corder, K., Ekelund, U., Steele, R.M., Wareham, N.J., & Brage, S. (2008). Assessment of
18 physical activity in youth. *Journal of Applied Physiology*, 105, 977-987.
- 19 Curran, T., Hill, A., Ntoumanis, N., Hall, H., & Jowett, G. (2016). A three-wave longitudinal
20 test of self-determination theory's mediation model of engagement and disaffection in
21 youth sport. *Journal of Sport and Exercise Psychology*, 38, 15-29.
- 22 Ebesutani, C., Regan, J., Smith, A., Reise, S., Higa-McMillan, C., & Chorpita, B. (2012). The
23 10-item positive and negative affect schedule for children, child and parent shortened
24 versions: Application of item response theory form more efficient assessment. *Journal*
25 *of Psychopathology and Behavioral Assessment*, 34, 191-203.

- 1 Eisenmann, J., Laurson, K., Wickel, E., Gentile, D., & Walsh, D. (2007). Utility of pedometer
2 step recommendations for predicting overweight in children. *International Journal of*
3 *Obesity*, 31, 1179-1182.
- 4 Fairclough, S., Stratton, G., & Baldwin, G. (2002). The contribution of secondary school
5 physical education to lifetime physical activity. *European Physical Education*
6 *Review*, 8, 69-84.
- 7 Francis, C., Longmuir, P., Boyer, C., Andersen, L., Barnes, J., & Boiarskaia, E., ... Tremblay,
8 M. (2016). The Canadian assessment of physical literacy: Development of a model of
9 children's capacity for a healthy, active lifestyle through a Delphi process. *Journal of*
10 *Physical Activity and Health*, 13, 214-222.
- 11 Gagne, M., Ryan, R. M. & Bargmann, K. (2003). Autonomy support and need satisfaction in
12 the motivation and well-being of gymnasts. *Journal of Applied Sport Psychology*,
13 15(4), 372-390.
- 14 Godin, G., Shephard, R. J. (1997). Godin leisure-time exercise questionnaire. *Medicine and*
15 *Science in Sports and Exercise*. 29, S36-S38.
- 16 Gunnell, K., Longmuir, P., Woodruff, S., Barnes, J., Belanger, K., & Tremblay, M. (2018).
17 Revising the motivation and confidence domain of the Canadian assessment of
18 physical literacy. *BMC Public Health*, 18(S2).
- 19 Hair, J.F., Black, W.C., Babin, B.J., & Anderson, R.E. (2010). *Multivariate data analysis*.
20 *Seventh edition*. Upper Saddle River, NJ: Prentice Hall.
- 21 Hallal, P., Victora, C., Azevedo, M., & Wells, J. (2006). Adolescent physical activity and
22 health. *Sports Medicine*, 36, 1019-1030.
- 23 Hay, J.A. (1992). Adequacy in and predilection for physical activity in children. *Clinical*
24 *Journal of Sport Medicine*, 2, 192-201.

- 1 Healthy Active Living and Obesity Research Group/HALO. (2014). *Canadian assessment of*
2 *physical literacy-first edition: Manual for test administration*. Ottawa, ON: Children's
3 Hospital of Eastern Ontario Research Institute.
- 4 Healthy Active Living and Obesity Research Group/HALO. (2017). *Canadian assessment of*
5 *physical literacy second edition: Manual for test administration*. Ottawa, ON:
6 Children's Hospital of Eastern Ontario Research Institute.
- 7 Hidding, L.M., Chinapaw, M.J.M., van Poppel, M.N.M., Mokkink, L.B., & Altenburg, T.M.
8 (2018). An updated systematic review of childhood physical activity questionnaires.
9 *Sports Medicine*, 48, 2797-2842.
- 10 International Physical Literacy Association. (2017). *Definition of physical literacy*. Retrieved
11 from www.physical-literacy.org.uk.
- 12 Janssen, I., & LeBlanc, A. G. (2010). Systematic review of the health benefits of physical
13 activity and fitness in school-aged children and youth. *International Journal of*
14 *Behavioral Nutrition and Physical Activity*, 7, 40.
- 15 Katzmarzyk, P., & Mason, C. (2009). The physical activity transition. *Journal of Physical*
16 *Activity and Health*, 6, 269-280.
- 17 Lang, J., Chaput, J., Longmuir, P., Barnes, J., Belanger, K., & Tomkinson, G., ... Tremblay,
18 M. (2018). Cardiorespiratory fitness is associated with physical literacy in a large
19 sample of Canadian children aged 8 to 12 years. *BMC Public Health*, 18(S2).
- 20 Longmuir, P., Boyer, C., Lloyd, M., Borghese, M., Knight, E., & Saunders, T., ... Tremblay,
21 M. (2017). Canadian agility and movement skill assessment (CAMSA): Validity,
22 objectivity, and reliability evidence for children 8–12 years of age. *Journal of Sport*
23 *and Health Science*, 6, 231-240.

- 1 Longmuir, P., Boyer, C., Lloyd, M., Yang, Y., Boiarskaia, E., Zhu, W., & Tremblay, M.
2 (2015). The Canadian assessment of physical literacy: Methods for children in grades
3 4 to 6 (8 to 12 years). *BMC Public Health*, 15(1).
- 4 Longmuir, P. & Tremblay, M. S. (2016). Top 10 research questions related to physical
5 literacy. *Research Quarterly for Exercise and Sport*, 87, 28-35.
- 6 Lubans, D., Morgan, P., Cliff, D., Barnett, L., & Okely, A. (2010). Fundamental movement
7 skills in children and adolescents. *Sports Medicine*, 40, 1019-1035.
- 8 Marsh, H., Hau, K., & Wen, Z. (2004). In search of golden rules: Comment on hypothesis-
9 testing approaches to setting cutoff values for fit indexes and dangers in
10 overgeneralizing Hu and Bentler's (1999) findings. *Structural Equation Modeling: A*
11 *Multidisciplinary Journal*, 11, 320-341.
- 12 Meredith, M. & Welk, G. (Eds.). (2010). *Fitness Gram and Activity Gram test administration*
13 *manual*. Champaign, IL: Human Kinetics.
- 14 Ntoumanis, N., & Standage, M. (2009). Motivation in physical education classes. *Theory and*
15 *Research in Education*, 7, 194-202.
- 16 Papaioannou, A., Bebetos, E., Theodorakis, Y., Christodoulidis, T., & Kouli, O. (2006).
17 Causal relationships of sport and exercise involvement with goal orientations,
18 perceived competence and intrinsic motivation in physical education: A longitudinal
19 study. *Journal of Sports Sciences*, 24, 367-382.
- 20 Poitras, V., Gray, C., Borghese, M., Carson, V., Chaput, J., & Janssen, I., ... Tremblay, M.
21 (2016). Systematic review of the relationships between objectively measured physical
22 activity and health indicators in school-aged children and youth. *Applied Physiology,*
23 *Nutrition, and Metabolism*, 41, S197-S239.
- 24 Reeve, J., Jang, H., Carrell, D., Jeon, S., & Barch, J. (2004). Enhancing students' engagement
25 by increasing teachers' autonomy support. *Motivation and Emotion*, 28(2), 147-169.

- 1 Reeve, J., & Tseng, C. (2011). Agency as a fourth aspect of students' engagement during
2 learning activities. *Contemporary Educational Psychology*, 36, 257-267.
- 3 Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in*
4 *motivation, development and wellness*. New York, NY: The Guilford Press.
- 5 Ryan, R. M., & Frederick, C. M. (1997). On energy, personality and health: Subjective
6 vitality as a dynamic reflection of well-being. *Journal of Personality*, 65, 529-565.
- 7 Sallis, J., Bull, F., Guthold, R., Heath, G., Inoue, S., & Kelly, P., ... Hallal, P. (2016).
8 Progress in physical activity over the Olympic quadrennium. *The Lancet*, 388, 1325-
9 1336.
- 10 Sallis, J., McKenzie, T., Beets, M., Beighle, A., Erwin, H., & Lee, S. (2012). Physical
11 education's role in public health: Steps forward and backward over 20 years and
12 HOPE for the future. *Research Quarterly for Exercise and Sport*, 83, 125-135.
- 13 Skinner, E., & Belmont, M. (1993). Motivation in the classroom: Reciprocal effects of teacher
14 behavior and student engagement across the school year. *Journal of Educational*
15 *Psychology*, 85, 571-581.
- 16 Society of Health and Physical Educators America. (2013). *National standards for K-12*
17 *physical education*. Reston, VA: SHAPE America.
- 18 Standage, M., Duda, J., & Ntoumanis, N. (2003). A model of contextual motivation in physical
19 education: Using constructs from self-determination and achievement goal theories to
20 predict physical activity intentions. *Journal of Educational Psychology*, 95, 97-110.
- 21 Standage, M., & Gillison, F. (2007). Students' motivational responses toward school physical
22 education and their relationship to general self-esteem and health-related quality of
23 life. *Psychology of Sport and Exercise*, 8, 704-721.
- 24 Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). New York:
25 Allyn and Bacon.

- 1 Taylor, I., & Lonsdale, C. (2010). Cultural differences in the relationships among autonomy
2 support, psychological need satisfaction, subjective vitality, and effort in British and
3 Chinese physical education. *Journal of Sport and Exercise Psychology*, 32, 655-673.
- 4 Taylor, I., Ntoumanis, N., Standage, M., & Spray, C. (2010). Motivational predictors of
5 physical education students' effort, exercise intentions, and leisure-time physical
6 activity: A multilevel linear growth analysis. *Journal of Sport & Exercise*
7 *Psychology*, 32, 99-120.
- 8 Telema, R., Yang, X., Leskinen, E., Kankaanpaa, A., Hirvensalo, M., Tammelin, T., ...
9 Raitakari, O. T. (2014). Tracking of physical activity from early childhood through
10 youth into adulthood. *Medicine & Science in Sports & Exercise*, 46, 955–962.
- 11 Tremblay, M., Barnes, J., González, S., Katzmarzyk, P., Onywera, V., Reilly, J., &
12 Tomkinson, G. (2016). Global matrix 2.0: Report card grades on the physical activity
13 of children and youth comparing 38 countries. *Journal of Physical Activity and*
14 *Health*, 13, S343-S366.
- 15 Tremblay, M. & Lloyd, M. (2010). Physical literacy measurement – The missing piece.
16 *Physical and Health Education*, 76, 26-30.
- 17 Tremblay, M., Longmuir, P., Barnes, J., Belanger, K., Anderson, K., & Bruner, B., ...
18 Woodruff, S. J. (2018). Physical literacy levels of Canadian children aged 8–12 years:
19 Descriptive and normative results from the RBC Learn to Play–CAPL project. *BMC*
20 *Public Health*, 18(S2).
- 21 Tudor-Locke, C., McClain, J., Hart, T., Sisson, S., & Washington, T. (2009). Expected values
22 for pedometer-determined physical activity in youth. *Research Quarterly for Exercise*
23 *and Sport*, 80, 164-174.
- 24 UNESCO/United Nations Educational, Scientific and Cultural Organization. (2015). Quality
25 physical education: Guidelines to policy makers. Paris, France: UNESCO.

- 1 Vandorpe, B., Vandendriessche, J., Vaeyens, R., Pion, J., Matthys, S., & Lefevre, J., ...
- 2 Lenoir, M. (2012). Relationship between sports participation and the level of motor
- 3 coordination in childhood: A longitudinal approach. *Journal of Science and Medicine*
- 4 *in Sport*, 15, 220-225.
- 5 Whitehead, M. (Ed.). (2010). *Physical literacy: Throughout the lifecourse*. New York, NY:
- 6 Routledge.
- 7 World Health Organization. (2010). *Global recommendations on physical activity for health*.
- 8 Geneva: WHO.
- 9 World Health Organization. (2017). *Depression and other common mental disorders: Global*
- 10 *health estimates*. Retrieved from
- 11 [http://apps.who.int/iris/bitstream/10665/254610/1/WHO-MSD-MER-2017.2-](http://apps.who.int/iris/bitstream/10665/254610/1/WHO-MSD-MER-2017.2-eng.pdf?ua=1)
- 12 [eng.pdf?ua=1](http://apps.who.int/iris/bitstream/10665/254610/1/WHO-MSD-MER-2017.2-eng.pdf?ua=1).

1 *Table 1*

2 Means, Standard Deviations, Reliabilities, and Correlations between Study Variables

Variable	<i>M</i>	<i>SD</i>	<i>α</i>	1	2	3	4	5	6	7	8	9	10
1. Physical literacy	68.77	10.47	-	-									
2. Engagement in PE	4.96	.83	-	.50**	-								
3. Agentic engagement	3.99	1.17	.83	.37**	.77**	-							
4. Behavioral engagement	5.81	.80	.81	.38**	.75**	.39**	-						
5. Emotional engagement	5.45	1.16	.86	.51**	.82**	.51**	.64**	-					
6. Cognitive engagement	4.69	1.16	.87	.31**	.77**	.41**	.44**	.49**	-				
7. Leisure-time exercise behavior	60.41	33.36	-	.38**	.30**	.21*	.22*	.24**	.26**	-			
8. Positive affect	3.79	.70	.78	.39**	.47**	.31**	.33**	.47**	.37**	.23**	-		
9. Negative affect	1.65	.55	.61	-.19*	-.05	.05	-.12	-.05	-.06	.02	-.31**	-	
10. Vitality	4.70	1.12	.86	.52**	.59**	.43**	.42**	.53**	.45**	.28**	.75**	-.31**	-

3 ** . Correlation is significant at the 0.01 level (2-tailed).

4 * . Correlation is significant at the 0.05 level (2-tailed).

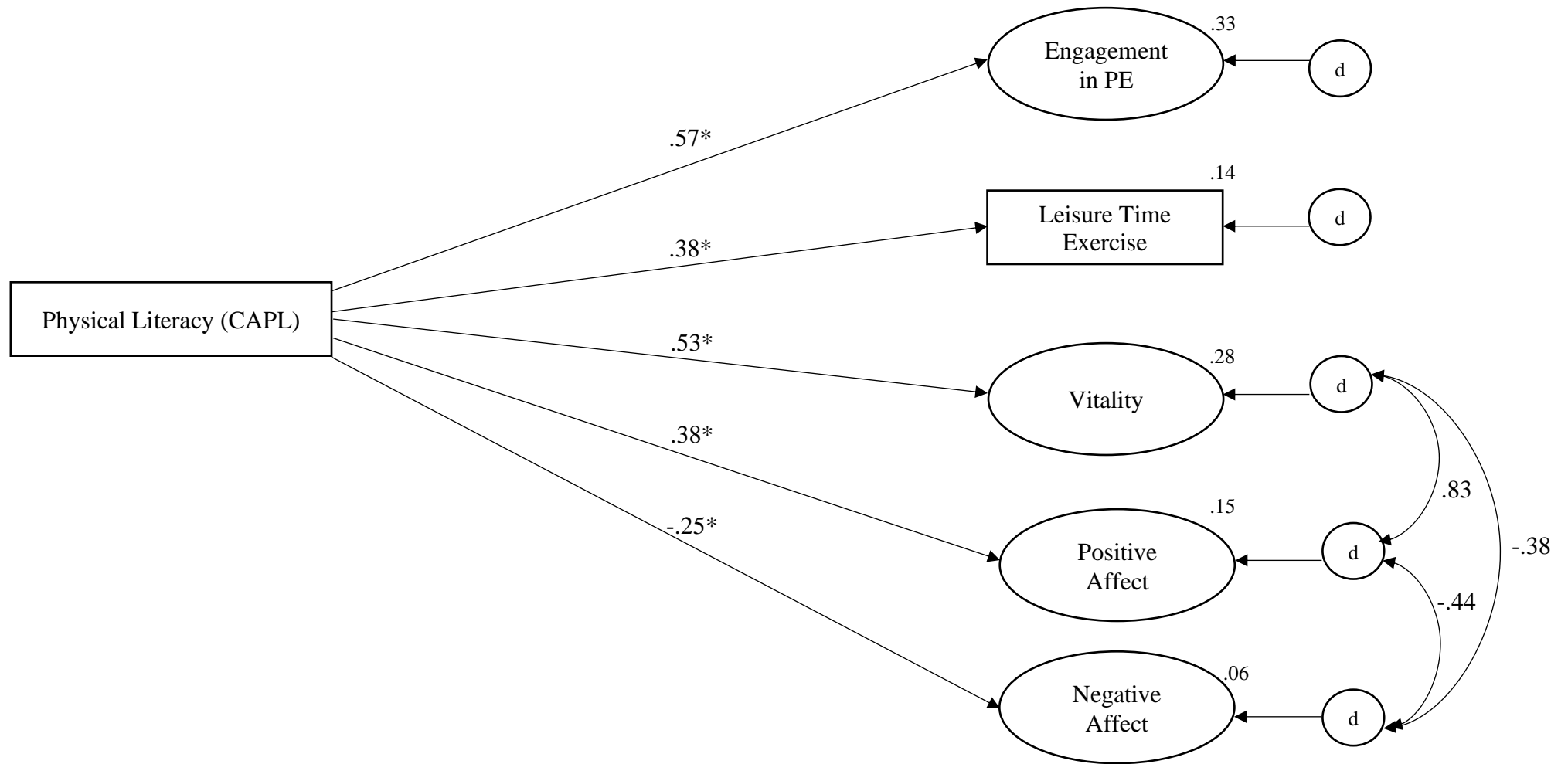


Figure 1: Structural equation model of relationships between physical literacy and outcome variables

*. Denotes statistically significant path